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Native Language Similarity during Foreign Language Learning: Effects of Cognitive Strategies and Affective States

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According to the US Department of State, a native English speaker can learn Spanish in about 600 h, but would take four times as long to learn Japanese. While it may be intuitive that similarity between a foreign language and a native tongue can influence the ease of acquisition, what is less obvious are the specific cognitive and emotional processes that can lead to different outcomes. Here, we explored the influence of cognitive strategies and affective states on native English speakers' ability to learn artificial foreign words that vary in their similarity to the native language. Explicit word learning strategies were reported more often, and were more effective for learners of a more similar language, and cognitive strategies were especially helpful for learners with lower moods. We conclude that language similarity, strategy, and affect dynamically interact to ultimately determine success at learning novel languages.

Learning a new language can take on many different forms. A Syrian refugee may learn German to start a new life, and an American student may take Spanish to fulfill a course requirement. How successfully individuals learn foreign languages will similarly depend on many different variables, including their motivation, abilities, and learning context. Here, we explore the interaction among cognitive, affective, and linguistic variables by examining how strategy-use and mood impact native English speakers' ability to learn languages that are more or less similar to the native tongue. Language learners often seek out similarities between the foreign and native language in order to make use of their existing knowledge (Ringbom 2007). Indeed, similarity between languages has been shown to predict novel language acquisition, both in the lab (Gathercole *et al.* 1999; Frisch *et al.* 2000; Roodenrys and Hinton 2002; Thorn and Frankish 2005; Ringbom and Jarvis 2009), as well as in everyday settings such as when immigrant populations learn a new language (Chiswick and Miller 1999; Beenstock *et al.* 2001). While the effects of language similarity on proficiency are often attributed to factors beyond the learner's direct control (e.g. the ability to discriminate between different phonemes; Ellis and Beaton 1993), differences in abilities may subsequently alter the explicit strategies that learners choose to adopt. Furthermore, the ease with which a language is learned is likely to have cascading effects on not only cognitive factors, including strategy-use, but also affective factors like mood and confidence. Implicit abilities, explicit strategies, and affective states all play a role in determining how successfully a foreign language is acquired. While there has been substantial interest in investigating each of these components in isolation, as well as how they vary across individuals, relatively less is understood about how they interact and impact learning across different languages. Here, we take a holistic approach by examining the downstream cognitive and affective consequences of exposure to languages of varying linguistic distance from the native tongue, and the ultimate outcome for language learning.

LANGUAGE SIMILARITY

The relationship between language similarity and proficiency has largely been attributed to differences in the extent to which learners can utilize knowledge of one language to learn another (i.e. 'cross-linguistic transfer' or 'cross-linguistic influence'; Ringbom 2007; Jarvis and Pavlenko 2008). Cross-linguistic transfer can be observed at multiple levels, including phonology (Melby-Lervåg and Lervåg 2011; Wrembel 2011), orthography (Ellis 2008), lexico-semantics (Ringbom 2007; Ecke 2015), morphology (Lowie 2000), syntax (Cuza 2013), and pragmatics (Bou-Franch 1998), and can be either positive (i.e. facilitation) or negative (i.e. errors) depending on how appropriate it is for learners to generalize from one language to the other. The benefits of cross-linguistic transfer (i.e. positive transfer) are therefore contingent on the match between new and previously acquired languages in respect to form, function, or meaning, and such overlap is generally more common among typologically similar languages (such as those belonging to the same language family, e.g. Spanish and Portuguese). It has been suggested, however, that more important than a common historical ancestry may be the real or perceived similarity (i.e. psychotypology, Kellerman 1978) of particular features and constructions across languages (e.g. word forms, syntax). For instance, though research on third language acquisition has demonstrated that the source language for transfer (the first language (L1) or the second language (L2)) is often the one that is most typologically related to the L3, the source language can vary depending on formal similarities that are perceived on a construction-by-construction basis (Rast 2010; see also Tolentino and Tokowicz 2011; Ivaska and Siitonen 2017). As the subjective nature of perceived similarity can be challenging to operationalize, the present experiment manipulates objective similarity to L1 word forms, and is restricted to the early stages of vocabulary acquisition when learners may also be most reliant on their native tongue (see Parkinson and Dinsmore 2019 for a discussion of how language knowledge, strategies, and interest develop over time).

At the word level, cross-linguistic transfer is most readily observed in the case of cognates, or words that overlap across languages in both form and meaning (Lotto and De Groot 1998; De Groot and Keijzer 2000). It is easy to intuit that a native English speaker may find it easier to remember the French word for table (‘*table*’) than the word for bathtub (‘*baignoire*’). However, even without completely overlapping forms and meanings, similarities between languages in how sounds and letters are combined can facilitate vocabulary acquisition (Storkel 2001; Storkel *et al.* 2006; Bartolotti and Marian 2017). One reason is that language similarity affects how easily a word can be mentally and vocally rehearsed. Individual differences in the ability to repeat non-words predict language learning (Service 1992), and suppressing a learner’s articulatory rehearsal disrupts vocabulary acquisition (Papagno *et al.* 1991). This suggests that successful encoding of a novel word depends to some extent on our ability to rehearse its phonological form (particularly during early stages of acquisition), and it is easier to rehearse words that resemble those of languages we already know. Additionally, even when the exact forms of novel words cannot be retrieved, familiar sequences can be reconstructed based on an understanding of phonotactic rules and regularities (Gathercole *et al.* 1999). Familiar-sounding words may also be easier to remember because they activate similar words in the native language that can act as a cue (Roodenrys and Hinton 2002). While such processes may be largely implicit, we propose that they may ultimately give rise to changes in the number and type of strategies that learners explicitly adopt when beginning to learn a new language.

COGNITIVE STRATEGIES

Explicit learning strategies have proven useful for the successful acquisition of foreign languages (Oxford 1992). The particular strategies learners adopt, however, depend both on factors related to the task itself (e.g. learning vocabulary versus discussing a story in a foreign language), as well as individual and sociocultural differences (Schmitt 2000; Oxford *et al.* 2004; Chamot 2005; Izura *et al.* 2014). The number and types of strategies that language learners use also depend on proficiency (Ikeda and Takeuchi 2003; Vandergrift 2003). At the word level, beginners may be more likely to adopt ‘shallow’ strategies such as rote memorization or repetition, while more advanced learners may utilize ‘deeper’ tactics such as the use of imagery or building associations (Schmitt 2000; Mokhtar *et al.* 2010). The degree of facilitation from previously acquired languages is also likely to vary depending on the learners’ level of expertise in the new language and the extent to which words are directly linked to their associated concepts or are lexically mediated through their L1 translations (e.g. Kroll and Stewart 1994). The utility of transfer-based strategies may therefore vary across time, and research suggests that successful language learners are those who are able to flexibly utilize different strategies depending on the task (Gu and Johnson 1996; Chamot and El-Dinary 1999).

While studies have examined variability in strategy-use among speakers of different L1s (e.g. Politzer and McGroarty 1985; Oxford and Burry-Stock 1995; Grainger 1997; see Oxford 1996 for review), linguistic similarity between the foreign and native language can be conflated with other attributes that influence strategy-use, including language attitudes (Tódor and Dégi 2016), cultural and linguistic identity (Khatib and Ghamari 2011), pedagogical norms (Oxford 1996), and the frequency and nature of exposure to the foreign language and its speakers (Adamuti-Trache *et al.* 2018). Even among speakers of the same native language, a person learning Spanish is likely to have a number of different experiences, traits, and motivations compared to someone learning Japanese, many of which will be unrelated to characteristics of the languages themselves. Still, there is evidence of differences in strategy-use across languages that may be more related to linguistic variables. White (1995) observed that English speakers learning Japanese were more likely to utilize repetition and writing-out strategies relative to those learning French, plausibly due in part to the rote nature of practicing the Japanese orthographic system of *kanji*. Okada, Oxford, and Abo (1996; cited by Grainger 2005) observed that certain strategies such as rhyming were less likely to be employed by native English speakers learning Japanese relative to those learning Spanish, likely as a result of differences in phonotactic overlap. In other words, while findings comparing natural languages can be difficult to interpret due to multiple possible confounds such as the social context of acquisition and use, there is evidence consistent with the notion that similarity to native language word forms may influence the strategies that learners employ.

AFFECT AND CONFIDENCE

In addition to cognitive abilities and learning strategies, successful acquisition of a new language also depends on how learners feel. Factors such as motivation (MacIntyre 2002), mood (Pishghadam 2009), and anxiety (Dewaele *et al.* 2008) reliably influence language learning outcomes. It is therefore 'at least as important to manage feelings as it is to use more cognitive strategies, since negative feelings reduce the effectiveness of most learning activities' (Ehrman *et al.* 2003; see MacIntyre and Gregersen 2012 for a review of the effects of anxiety and emotion on foreign language learning). Language learning can additionally be facilitated by positive affective states, including motivation, which Gardner (1985: 10) describes in the context of language learning as 'the combination of effort plus desire to achieve the goal of learning the language.' Among the factors that contribute to motivation are positive attitudes and confidence (Ehrman *et al.* 2003), both of which can have a bidirectional relationship with foreign language aptitude. For instance, positive feedback and demonstrable progress increase confidence (Noels 2001; Raoofi *et al.* 2012), which in turn can fuel greater motivation and further learning (Hsieh and Schallert 2008; see Pajares 2003 and Raoofi *et al.* 2012 for reviews). Motivation can further be considered with respect to a learner's attitude towards communities associated with the target language, which provides a socially motivated impetus for language achievement (i.e. an *integrative orientation;* Gardner 1985).

In addition to affective variables directly associated with language learning (e.g. anxiety, motivation), acquisition can be facilitated or hindered by incidental and transient emotional states such as mood (Miller *et al.* 2018; Liu 2019). For instance, Miller *et al.* (2018) found that performance on a paired-associates vocabulary task was adversely affected by the induction of negative moods (through video clips) and conjecture that negative emotional states may disrupt the process of mapping novel forms to meaning via their native language translations. On the other hand, Liu (2019) recently observed that negative mood induction (through music) enhances semiartificial grammar learning, and suggests that negative moods may promote a more analytical and careful mode of processing. In this way, learners' affective states can have distinct effects on performance depending on task demands, with potential downstream consequences for motivation and attitudes towards the language learning process.

Characteristics of the learning task, including similarity between one's native tongue and a novel language, are additionally likely to influence the emotions that individuals experience during language acquisition and practice. For instance, the greater challenges associated with learning a highly dissimilar language may be more likely to threaten the learner's confidence. Indeed, in qualitative studies of language learners, perceived task difficulty has been found to be associated with reduced confidence and motivation to continue learning (Graham 2004; Wang and Pape 2007). This may partly explain Samimy and Tabuse's (1992) finding that native English speakers learning Japanese experienced a significant decrease in both motivation and attitude over the course of a year—a non-trivial fact considering that motivation was the strongest predictor of final grades. It is therefore important to understand how learning particular languages impacts affect, as well as how affect influences language learning.

However, as with cognitive strategies, isolating the effect of language similarity on learners' affect can be difficult when studying natural languages, as there will inevitably be numerous differences between languages other than linguistic characteristics. We therefore investigate the effects of similarity on participants' reported affect by randomly assigning native English speakers in the USA to learn vocabulary from one of two artificial languages that varied in their phonotactic similarity to English. Artificial languages have been widely used to study natural language processes ranging from statistical learning of word boundaries (e.g. Mitchel and Weiss 2010) to the acquisition of novel grammars (Morgan-Short *et al.* 2010, 2012). Systematic comparisons of natural and artificial languages have revealed significant overlap in neural activation (Friederici *et al.* 2002), as well as behavioural metrics of language aptitude (Ettlinger *et al.* 2016). Importantly, the use of artificial languages enabled us to control for confounds such as prior experience and sociocultural associations with the target language of the task, as well as to isolate the impact of word form similarity from other sources of linguistic variance (e.g. syntax, pragmatics).

Given that the influence of affect on learning can be both direct (e.g. disruptive effects of anxiety of memory encoding; MacIntyre and Gardner 1989; Sellers 2000), as well as indirect (e.g. high motivation and confidence leading to the adoption of more cognitive learning strategies; Oxford 1989; Magogwe and Oliver 2007; Li and Wang 2010), any effects of language similarity on affective states may also impact cognitive processes (and vice versa). The present study thus simultaneously examines how linguistic similarity to the native language impacts the use of cognitive strategies, the experience of affective states, and subsequently, learning outcomes.

METHODS

Participants

Sixty-two native English speakers (96.8% female[1]) with a mean (SD) age of 25.4 years (2.10) were included in the analysis; three additional participants were excluded from the analysis because they were non-native English speakers. Participants were recruited at a Midwestern university in the USA in exchange for course credit, and informed consent was obtained in accordance with the university's Institutional Review Board. Participants' verbal memory was assessed using the verbal paired-associates test of the Wechsler Memory Scale III (Wechsler 1997), with an average scaled score of 13.6 ($SD = 2.8$). Language background was assessed using the *Language Experience and Proficiency Questionnaire* (LEAP-Q; Marian *et al.* 2007). Participants reported an average English proficiency of 9.82 out of 10 ($SD = 0.46$), averaged across speaking, understanding, and reading, and all participants began acquiring English before the age of 2 ($M = 0.24$; $SD = 0.50$). Approximately half of the participants ($N = 33$) reported knowledge of a language other than English, with an average non-English proficiency of 5.01 out of 10 ($SD = 2.38$) and average age of acquisition of 9.06 ($SD = 6.14$). Non-English languages included Spanish ($N = 21$), French ($N = 4$), Tagalog ($N = 2$), and Arabic, Cantonese, German, Hebrew, Hindi, and Kachi ($N = 1$ for each). Multilingual participants estimated that they were exposed to a non-English language ~8.8% ($SD = 12.7$) of the time. Participants were randomly assigned to learn artificial language vocabulary with word forms that were similar ('Familiar'; $N = 30$) or dissimilar to English ('Unfamiliar'; $N = 32$). The two groups did not significantly differ from each other in gender, age, verbal memory, English proficiency, age of English acquisition, multilingual status, non-English proficiency, or amount of non-English exposure (all $p > 0.05$). The age of non-English acquisition, however, was earlier among multilinguals in the Familiar language group ($M = 7.13$, $SD = 5.52$) than in the Unfamiliar language group ($M = 11.68$, $SD = 6.14$; $t(26.3) = 2.19$, $p = 0.037$); and therefore, analyses of vocabulary acquisition included verbal memory and language background measures as covariates.

MATERIALS

Each artificial language consisted of 48 novel words. To build the languages, we began by randomly generating 10,000 non-words with alternating consonants and vowels (CVCVC). The letters Q and X were excluded from both languages due to their many illegal or very low frequency English bigrams, and Y was excluded to maintain the CVCVC structure for all non-words. Even though participants only saw the words' written forms during the task, we generated each word's phonological form using the eSpeak speech synthesizer software (version 1.48.15 for Linux; Duddington 2012) in order to assess the phonological characteristics of the words. Pronunciations were first International Phonetic Alphabet (IPA) transcribed using eSpeak's EN-US American English voice, and then translated from IPA to the CPSAMPA format (a version of the Extended Speech Assessment Methods Phonetic Alphabet, or XSAMPA). This was done in order to utilize the Cross-Linguistic Easy-Access Resource for Phonological and Orthographic Neighborhood Densities database (CLEARPOND; Marian *et al.* 2012) to determine the average bigram and biphone probabilities of the novel words in English. The averaged *z*-transformed bigram and biphone probabilities were then used as a measure of English similarity.

In order to select the words for the two languages, we began by determining the range of English similarity scores among real five-letter English words with a frequency-per-million of 0.33 or greater. The real English words were taken from SUBTLEXUS (Brysbaert and New 2009) and rank-ordered by English similarity as determined by their composite bigram and biphone probabilities, which were calculated using CLEARPOND (Marian *et al.* 2012). English similarity scores at or above the 20th percentile were considered high similarity, while those at or below the 99th percentile were considered low similarity. Based on these thresholds, 48 of the randomly generated high similarity novel words were selected for the Familiar language, and 48 low similarity novel words were selected for the unfamiliar language.

Once the forms of the novel words were selected, two versions of each language (Unfamiliar or Familiar) were created by pairing the novel words with one of two sets of English translations (English 1 or English 2). The two versions of each language were created in order to control for artefacts of particular novel-word/English pairings; the English translations were matched for lexical frequency (SUBTLEX−US zipf scale; Brysbaert and New 2009; Van Heuven *et al.* 2014), concreteness, and familiarity (Bristol norms; Stadthagen-Gonzalez and Davis 2006; all $p > 0.05$). Participants were randomly assigned to one of four groups to learn one list of 48 non-word—English word pairs: Unfamiliar—English1, Unfamiliar—English2, Familiar—English1, or Familiar—English2. See Table S1 in Supplementary Materials for full list of stimuli.

PROCEDURE

Participants were tested simultaneously in a large classroom setting under the supervision of an experimenter. All data were collected using paper and pencil questionnaires and response sheets. Before beginning the learning task, participants were asked to complete a questionnaire assessing affective states. Each question required a response on a 9-point scale, which contained descriptive labels (rather than numbers) at each point. The questions assessed (i) current mood (extremely unhappy to extremely happy), (ii) general mood (extremely unhappy to extremely happy), (iii) expected enjoyment of the task (completely unenjoyable to completely enjoyable), (iv) ability to learn new languages (extremely poor to extremely good), (v) ability to learn new vocabulary (extremely poor to extremely good), (vi) anticipated performance on the test (extremely poor to extremely good), and (vii) anticipated difficulty of the test (extremely difficult to extremely easy). Responses were later coded from −4 to 4 for analyses.

After completing the mood and confidence survey, participants began the language learning task. Participants were given 16 min to silently study 48 novel words from either the Familiar or Unfamiliar language paired with English translations (e.g. furen—stone), which were printed on a piece of paper. They were informed that they would be tested immediately after. For the test, participants received a sheet of paper with all 48 English words and were given six min to write the corresponding novel word translations. Following the test, participants completed the same mood and confidence questionnaire, this time evaluating their past performance on the test. Lastly, to assess strategy-use, participants were once again presented with the list of English words and were asked to indicate any strategies that they utilized to learn each word.

Data coding

Strategy Two independent coders categorized each reported strategy into one of eight categories (see Table 1). Inter-rater reliability was high (Cohen's $\kappa = 0.87$). For cases in which there was disagreement, the two original raters plus a third rater discussed the coding until a consensus was reached.

Affect In order to reduce the number of associated measures, we began by running a factor analysis on the seven affective variables. The analysis was conducted with the 'psych' (Revelle 2015) and 'GPArotation' (Bernaards and Jennrich 2005) packages in R (R Core Team 2015), utilizing an oblimin rotation and the minimum residual (Ordinary Least Squares) technique. Two composite affective measures were created based on factor loadings exceeding a cut-off of 0.4 (see Table 2 for factor loadings). The first measure, labelled 'Mood' was an average of participants' (i) 'current mood' and (ii) 'expected enjoyment of the task', weighted by their factor loadings. The second

Table 1: Strategy categories

Strategy	Description
Association	Making a lexical or semantic connection ('The **stone** is covered in **fur'** as an aid for **stone** = **fur**en)
Rote	Repeated study, subvocal, vocal, or written.
Grouping	Studying a few novel words with a shared feature (e.g. phonologically or semantically related).
Orthographic	Focusing on all or some of the word's letters.
Phonological	Remembering a word's pronunciation.
Drawing	Drawing the word's meaning as a visual aid.
Novelty	Words that look or sound unusual and stick out in memory.
None	

Table 2: Factor loadings for affective measures

Measure	Mood	Confidence
Current mood	0.777	
General mood		
Expected enjoyment	0.590	
Ability (vocabulary)		0.737
Ability (language)		0.589
Anticipated performance		0.838
Anticipated difficulty		0.660

measure, labeled 'Confidence' was a weighted average of participants' perceived (i) 'ability to learn new vocabulary', (ii) 'ability to learn new languages', (iii) 'anticipated performance on the test', and (iv) 'anticipated difficulty of the test'. The measure of 'general mood' did not load on to either factor and thus was not included in either composite measure.

Language learning (accuracy) Responses on the vocabulary test were manually transcribed onto a computer and then digitally scored for accuracy. Each word was given an accuracy score between 0 and 1, with 0.2 points added for each of the five correct letters recalled in the correct position (see Figure 1).

Correct Response: *FUREN*

$$\frac{\text{F}}{0.2}\ \frac{\text{U}}{0.2}\ \frac{\text{R}}{0.2}\ \frac{\text{E}}{0.2}\ \frac{\text{N}}{0.2} = 1.0$$

$$\frac{\text{F}}{0.2}\ \frac{\text{U}}{0.2}\ \frac{\text{R}}{0.2}\ \frac{\text{E}}{0.2}\ \frac{\text{D}}{0.0} = 0.8$$

$$\frac{\text{F}}{0.2}\ \frac{\text{U}}{0.2}\ \frac{\text{R}}{0.2}\ \frac{\text{N}}{0.0}\ \frac{\text{E}}{0.0} = 0.6$$

Figure 1: Example scoring for three possible responses to the target word 'furen'. Participants were given 0.2 points for each correct letter in the correct position for a maximum score of 1 per word.

Data analysis

Analyses utilized linear mixed effects models, which were fitted with the 'lme4' package (Bates *et al.* 2015), with the significance of fixed effects evaluated with the Satterthwaite approximation for degrees of freedom using the 'lmerTest' package (Kuznetsova *et al.* 2017), as were follow-up tests, which were run using the 'lsmeans' package (Lenth 2016). Family-wise error rates for follow-up tests were controlled for categorical predictors with Tukey-adjusted comparisons of the estimated marginal means, and for continuous predictors with Bonferroni-adjusted tests on the estimated slopes. Fixed effects of Strategy were treatment coded to compare each strategy (coded as 1) against no strategy (coded as 0). Fixed effects of Language were effect-coded (weighted) to compare the Familiar (+.48) and Unfamiliar (−.52) languages. All models included random intercepts for Subject and Item (the word to be learned) as justified by the design, as well as random slopes for fixed effects that varied within-subject and/or within-item. For cases in which the maximal model (Barr *et al.* 2013) failed to converge, the partially converged model was inspected and the random slope accounting for the least amount of variance was removed until convergence was achieved.

RESULTS

What strategies do language learners use?

We began by examining the effects of language similarity, mood, and confidence on the types of strategies that learners utilized. The number of words each participant studied with each strategy was entered as the outcome variable with fixed effects of Strategy (novelty, rote, association, grouping, phonological, orthographic, and drawing versus none), Language (Familiar versus Unfamiliar), Mood, Confidence, and all two- and three-way interactions with Strategy, Language, and each of the affective variables (Mood/ Confidence). The model additionally included a random intercept for Subject.[2] See Table S2 in Supplementary Materials for full output.

There were significant Language × Strategy interactions for Associations (*Estimate* = 5.54, *SE* = 1.68, 95% CI [2.39, 8.68], $t(448) = 3.29$, $p = 0.001$), and Rote (*Estimate* = 3.68, *SE* = 1.68, 95% CI [0.54, 6.82], $t(448) = 2.19$, $p = 0.029$), as well as a marginal interaction for Grouping (*Estimate* = 3.29, *SE* = 1.68, 95% CI [0.15, 6.43], $t(448) = 1.96$, $p = 0.051$). Follow-up pairwise comparisons revealed that building associations was the most commonly used strategy, and was used significantly more often by those learning the Familiar language than the Unfamiliar language (*Estimate* = 3.58, *SE* = 1.02, 95% CI [1.58, 5.58], $t(448) = 3.52$, $p < 0.001$; see Figure 2). On the other hand, those using the Unfamiliar language were significantly more likely to use no strategy (*Estimate* = −3.42, *SE* = 1.02, 95% CI [−5.42, −1.42], $t(448) = -3.36$, $p < 0.001$). The probability of employing all other strategies did not differ between languages (all $p > 0.05$; see Table S3 in Supplementary Materials). Overall, participants were significantly more likely to report using no strategy compared to any of the strategies (all $p < 0.001$).

There were significant effects of confidence for each of the strategies (all $p < 0.01$), with greater confidence associated with increased strategy-use. There

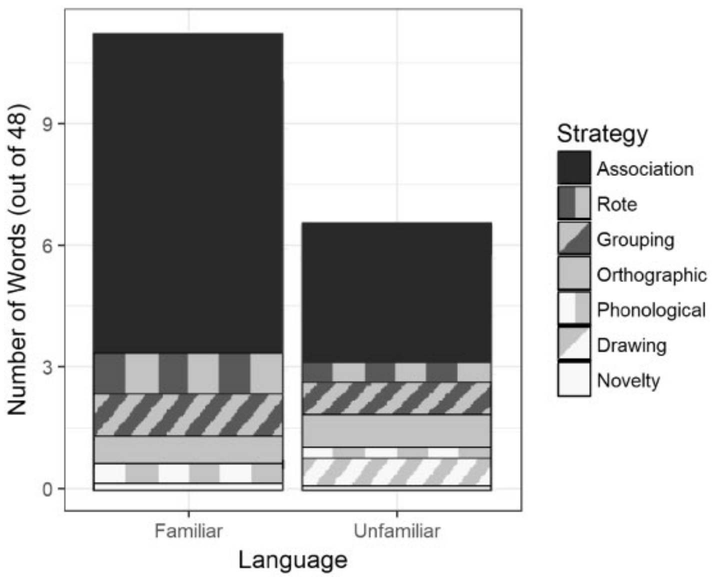

Figure 2: Number of words (out of 48) for which each strategy (association, rote, grouping, orthographic, phonological, drawing, and novelty) was used by the Familiar and Unfamiliar language-learning groups.

was additionally a significant three-way interaction between confidence, language, and the association strategy (*Estimate* = 4.88, *SE* = 1.69, 95% CI [1.73, 8.02], $z = 2.89$, $p = 0.004$). Follow-up tests revealed a significant effect of confidence on the use of the association strategy among those learning the Familiar language (*Estimate* = 3.19, *SE* = 0.66, 95% CI [1.88, 4.50], $z = 4.81$, $p < 0.001$), but not the Unfamiliar language (*Estimate* = 1.19, *SE* = 0.99, 95% CI [−0.76, 3.13], $z = 1.20$, $p > 0.9$; see Figure 3). Similarly, there was a significant effect of confidence on the use of no strategy for those learning the Familiar language (*Estimate* = −3.95, *SE* = 0.66, 95% CI [−5.25, −2.64], $z = -5.94$, $p < 0.001$), but not the Unfamiliar language (*Estimate* = −1.08, *SE* = 0.99, 95% CI [−3.03, 0.87], $z = -1.09$, $p > 0.9$). No other effects were significant (all $p > 0.05$).

There were no significant main effects of mood for any of the strategies (all $p > 0.05$), but there were significant three-way interactions between mood, language, and strategy for drawing (*Estimate* = −2.96, *SE* = 1.23, 95% CI [−5.26, −0.66], $t(448) = -2.40$, $p = 0.017$) and rote (*Estimate* = −3.08, *SE* = 1.23, 95% CI[−5.38, −0.78], $t(448) = -2.50$, $p = 0.013$). However, follow-up tests did not reveal significant effects of mood on strategy-use for either the Familiar or Unfamiliar languages (all $p > 0.05$), likely due to the fact that very few participants employed either Drawing ($N = 0$ and 2, respectively) or Rote ($N = 10$ and 6, respectively) strategies.

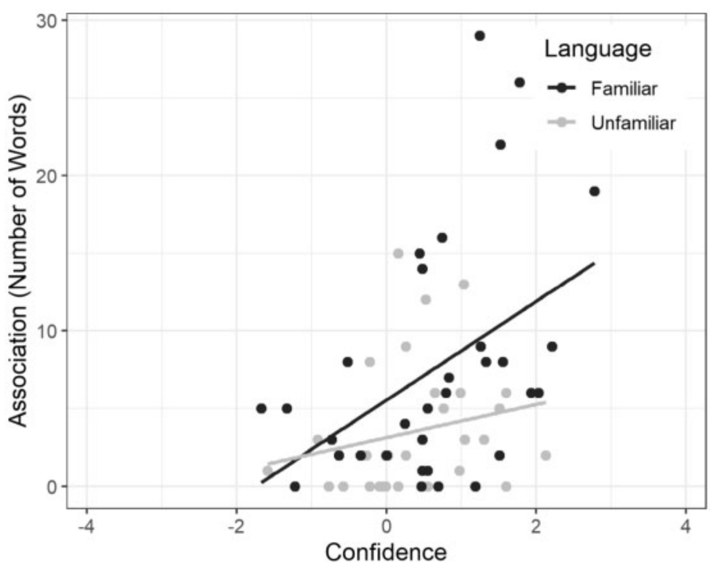

Figure 3: Relationship between confidence and the number of words for which participants utilized the association strategy in the Familiar and Unfamiliar language groups.

What variables predict vocabulary learning?

Strategy type and language similarity We began by entering accuracy on the vocabulary test as the response variable in a linear mixed-effects model with Strategy (each strategy against no strategy) and Language (Familiar vs. Unfamiliar), their interaction, Verbal Memory and Language Background[3] measures as fixed effects with random intercepts for Subject and Item.[4] Each of the strategies resulted in significantly higher accuracy than no strategy (all $p <$ 0.001) with the exception of drawing (p = 0.534; see Figure 4 and Table 3). There was additionally a main effect of Language such that accuracy was higher for the Familiar language (M = 0.34, SD = 0.42; calculated from the raw data) than the Unfamiliar language (M = 0.18, SD = 0.32; *Estimate* = 0.11, SE = 0.03, t(78.82) = 3.35, p = 0.001). While there were no significant interactions with Strategy, pairwise comparisons reveal that the associative strategy was significantly more effective at improving accuracy for the Familiar language than the Unfamiliar language (*Estimate* = 0.12, SE = 0.05, 95% CI [0.02, 0.22], t(363.7) = 2.46, p = 0.014), and accuracy was significantly higher for the Familiar language relative to the Unfamiliar language when no strategy was utilized (*Estimate* = 0.11, SE = 0.03, 95% CI [0.04, 0.18], t(78.8) = 3.35, p = 0.001; see Table S4 in Supplementary Materials for full output of follow-up tests).

Strategy frequency and affect Next, we examined whether learning outcomes were influenced by the number of words that were studied using any strategy,

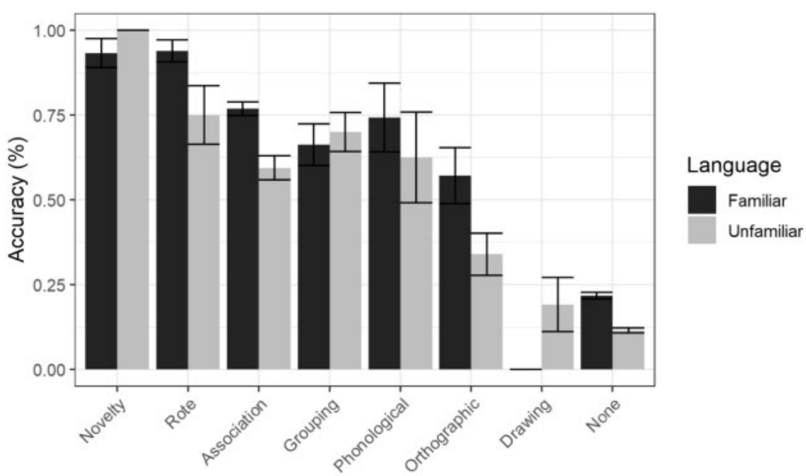

Figure 4: Accuracy for words that were studied using strategies related to novelty, rote memorization, association, grouping words, phonological features, orthographic features, drawing/visualization, and none. Error bars represent standard errors. Note that no Familiar words were practiced using the 'Drawing' strategy and that the number of total observations varied across strategies (see previous section of Results).

Table 3: Parameter estimates for linear mixed effect regression model of Strategy and Language on vocabulary learning

Fixed Effects	Estimate	*SE*	*df*	*t*	*p*-value
Intercept	−0.05	0.09	50.69	−0.54	0.593
Association	0.51	0.02	2714	24.39	<0.001***
Drawing	0.05	0.08	1912	0.62	0.534
Grouping	0.51	0.04	2628	12.37	<0.001***
Novelty	0.69	0.11	2683	6.51	<0.001***
Orthographic	0.27	0.05	2681	5.44	<0.001***
Phonological	0.38	0.07	2668	5.61	<0.001***
Rote	0.62	0.05	2690	13.23	<0.001***
Language	0.11	0.03	78.82	3.35	0.001**
Verbal_Memory	0.01	0.01	50.79	1.31	0.198
Multilingual_Status	−0.04	0.07	49.90	−0.52	0.606
NonEnglish_AoA	0.01	0.004	50.24	1.08	0.287
NonEnglish_Proficiency	0.02	0.01	51.14	1.62	0.112
NonEnglish_Exposure	0.003	0.002	50	1.41	0.164
Association: Language	0.01	0.04	2707	0.30	0.766
Grouping: Language	−0.10	0.08	2622	−1.17	0.242
Novelty: Language	−0.26	0.21	2679	−1.20	0.232
Orthographic: Language	0.07	0.10	2681	0.72	0.471
Phonological: Language	−0.04	0.14	2666	−0.29	0.771
Rote: Language	0.07	0.09	2690	0.75	0.455

***$p < 0.001$, **$p < 0.01$, . Each strategy was treatment coded (1) compared to no strategy (0). Language was effect-coded (weighted by sample size) to compare the Familiar (+0.48) to Unfamiliar (−0.52) language groups.

as well as the affective variables of mood and confidence for the Familiar and Unfamiliar languages. Accuracy on the vocabulary test was entered as the outcome variable in a linear mixed-effects model. Fixed effects were Language, Mood, Confidence, Strategy Frequency, all two- and three-way interactions between Strategy, Language, and each of the affect variables (Mood/ Confidence), as well as Verbal Memory and Language Background measures. The model additionally included random intercepts for Subject and Item, as well as a by-item random slope for Strategy Frequency.

Strategy frequency There was a significant main effect of Strategy Frequency on accuracy (*Estimate* = 0.01, *SE* = .003, 95% CI [0.01, 0.02], $t(40)=4.42$, $p < 0.001$), which did not interact with Language ($p = 0.420$; see Table S5 in Supplementary Materials for full output; see Figure 5).

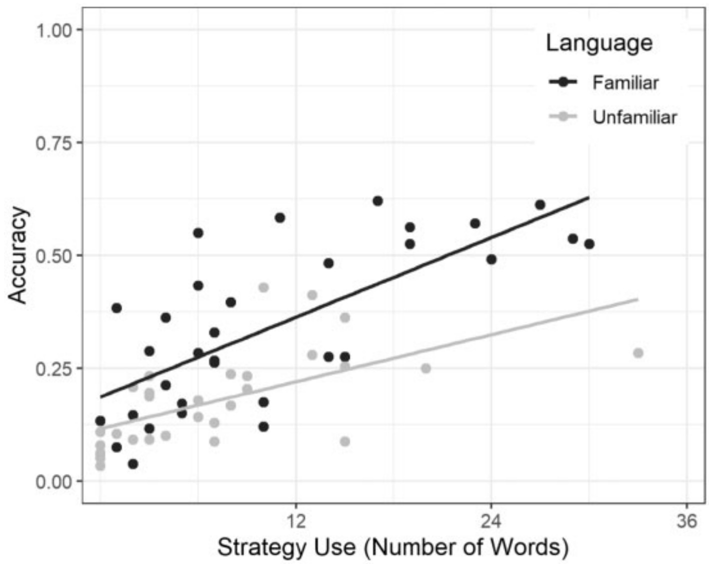

Figure 5: Relationship between the number of words for which an explicit strategy was reported and average accuracy on the vocabulary test for the Familiar and Unfamiliar language groups.

There was a significant interaction between Strategy Frequency and Mood (*Estimate* = −0.005, SE = 0.002, 95% CI [−0.01, −0.0001], $t(40) = -2.10$, $p =$ 0.042). In order to visualize this interaction, mood scores at or below the median of 0.57 were coded as 'low' and those above the median were coded as 'high'. As can be seen in Figure 6, the benefit of adopting more strategies was particularly pronounced for participants with lower mood scores. This trend did not interact with Language ($p = 0.408$), and Strategy Frequency did not interact with Confidence ($p = 0.170$).

Mood There was a main effect of pre-task Mood, with higher scores on the vocabulary test for participants with higher composite mood scores (*Estimate* = 0.06, *SE* = 0.02, 95% CI [0.02, 0.08], $t(40)=2.78$, $p = 0.008$; see Figure 7), as well as a significant interaction between Mood and Language (*Estimate* = 0.005, *SE* = 0.002, 95% CI [0.02, 0.08], $t(40) = 2.19$, $p = 0.034$). Planned comparisons revealed a significant positive association between Mood and accuracy for the Familiar language (*Estimate* = 0.04, *SE* = 0.02, 95% CI [0.007, 0.08], $z = 2.44$, $p = 0.029$), but not the Unfamiliar language (*Estimate* = −0.01, *SE* = 0.02, 95% CI [−0.05, 0.02], $z = 0.64$, $p > 0.9$).

The Familiar language group ($M_{pre} = 0.62$, $SD = 1.12$) did not differ from the Unfamiliar group ($M_{pre} = 0.22$, $SD = 1.35$) in their mood prior to taking the test (95% CI [−0.23, 1.03], $t(56.58) = 1.27$, $p = 0.206$). Mood following the test was significantly lower than before the test for both the Familiar

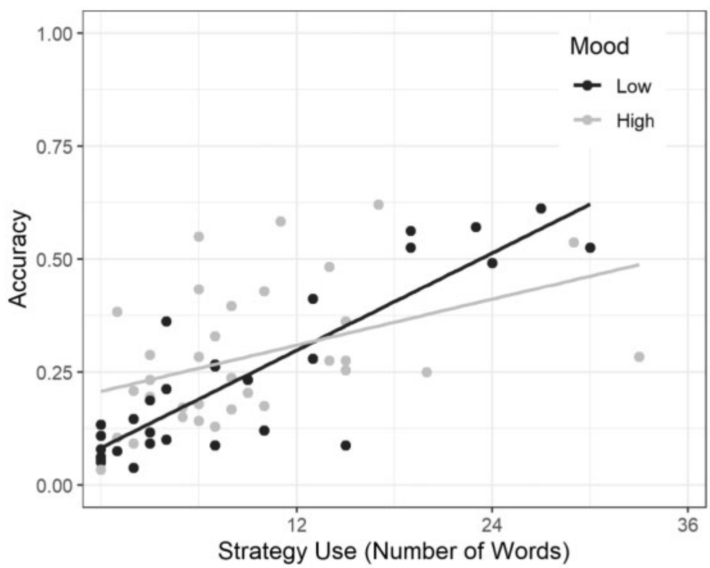

Figure 6: Relationship between the number of words for which an explicit strategy was adopted and accuracy on the vocabulary test for participants with mood scores at or below the median (0.57; i.e. 'low') and above the median (i.e. 'high').

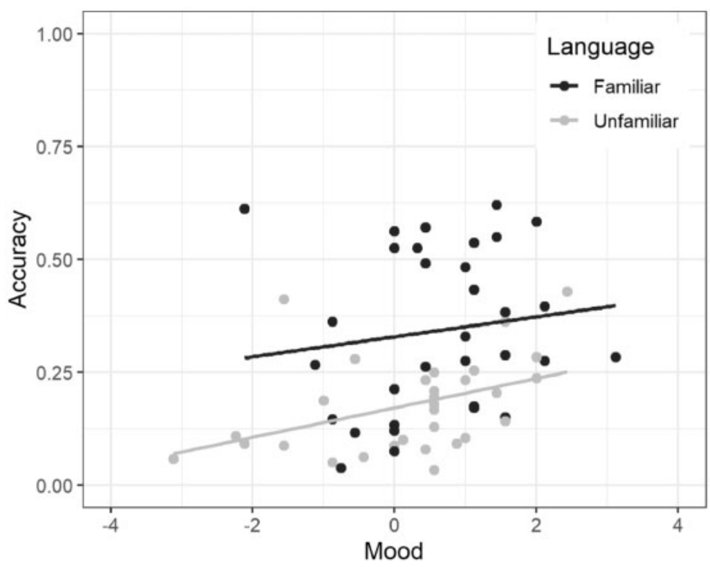

Figure 7: Relationship between mood and accuracy on the vocabulary test for participants learning the Familiar and Unfamiliar languages.

(M_{delta} = 1.05, SD = 1.37; 95% CI [0.56, 1.55], $t(31) = 4.35$, $p < 0.001$) and Unfamiliar groups (M_{delta} = 1.45, SD = 1.18; 95% CI [1.01, 1.89], $t(29)$ = 6.73, $p < 0.001$), and the groups did not differ from each other in the amount of change from pre to post test (95% CI [−1.05, 0.25], $t(59.60) = -1.23$, p = 0.224). However, the Familiar group ($M_{post} = -0.44$, SD = 1.47) rated their mood as significantly better than the Unfamiliar group ($M_{post} = -1.24$, SD = 1.61) following the test (95% CI [0.44, 1.24], $t(58.56) = 2.05$, $p = 0.045$).

Confidence There was a significant main effect of pre-task Confidence on word accuracy (*Estimate* = 0.05, SE = 0.02, 95% CI [0.01, 0.09], $t(40) = 2.16$, p = 0.037). While the interaction with Language did not reach significance (p = 0.170), planned comparisons revealed a significant effect of confidence for the Familiar language (*Estimate* = 0.06, SE = 0.02, 95% CI [0.02, 0.10], z = 2.93, p = 0.006), but not the Unfamiliar language (*Estimate* = −0.04, SE = 0.03, 95% CI [−0.10, 0.03], z = 1.13, p = 0.522; see Figure 8).

Participants in the Familiar language group (M_{pre} = 0.63, SD = 1.06) did not differ from those in the Unfamiliar group (M_{pre} = 0.37, SD = 0.83) in their confidence prior to taking the test (95% CI [−0.22, 0.75], $t(58.10) = 1.10$, p = 0.276). Confidence following the test was significantly lower than before the test for both the Familiar (M_{delta} = 1.59, SD = 1.11; 95% CI [1.19, 1.99], $t(31)$ = 8.14, $p < 0.001$) and Unfamiliar groups (M_{delta} = 2.09, SD = 1.04; 95% CI [1.71, 2.49], $t(29) = 11.06$, $p < 0.001$). However, the reduction in confidence was marginally greater for the Unfamiliar group (95% CI [−1.05, 0.04],

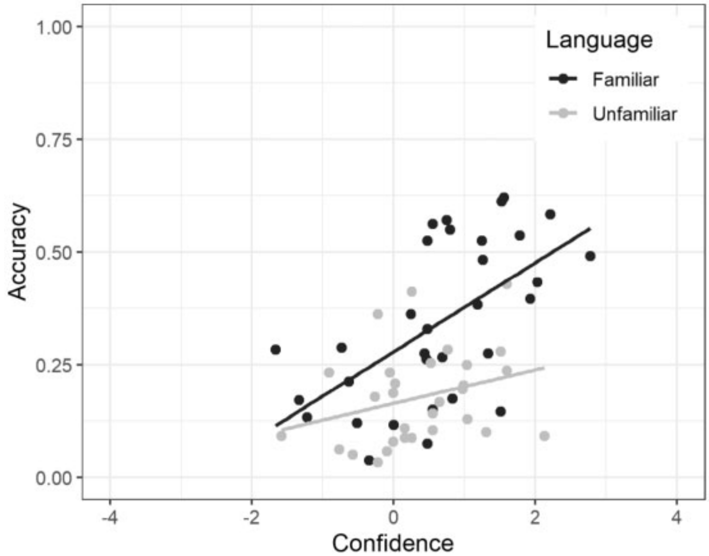

Figure 8: Relationship between confidence and accuracy on the vocabulary test for participants learning the Familiar and Unfamiliar languages.

$t(59.99) = -1.83$, $p = 0.068$). As a result, the Familiar group ($M_{post} = -0.96$, $SD = 1.38$) was significantly more confident than the Unfamiliar group ($M_{post} = -1.73$, $SD = 1.19$) following the test (95% CI [0.12, 1.42], $t(59.61) = 2.36$, $p = 0.021$).

DISCUSSION

We began by asking whether studying a language with variable similarity to one's native tongue impacts how individuals strategize, feel, and subsequently learn. As noted by Oxford *et al.* (2004), past work on language learning strategies has often relied on questionnaires assessing the tactics learners tend to use, without the inclusion of a learning task to determine the effectiveness of reported strategies. The addition of a performance-based exercise in the present study allowed us to assess both the use and efficacy of strategies for vocabulary acquisition. Additionally, by collecting measures of strategy-use, mood, confidence, and learning outcomes, we observed not only the effects of language similarity on each component individually, but also the ways in which cognitive and affective processes interact with one another.

Similarity to the native language affected the type and number of strategies that learners adopted when learning novel vocabulary. Those learning a more similar language utilized the association strategy to a greater extent than those learning a disparate language. Indeed, a comparable pattern has been observed with natural languages, where English speakers learning alphabet-based languages (French, Spanish, German, Italian) were more likely to report connecting novel foreign language words with native language words, while those learning character-based languages (Chinese, Japanese) more frequently relied on visualization and rote memorization (Han 2014). Such differences may be consequential as building associations has been shown to promote deeper encoding of novel vocabulary than tactics such as repetition and rote memorization (Cohen and Aphek 1981; Mokhtar *et al.* 2010). Papagno *et al.* (1991) found that participants learning foreign language words paired with native translations were relatively unaffected by a secondary articulatory suppression task so long as semantic associations could be generated. On the other hand, retention of word pairs that did not readily call semantic associations to mind was significantly impaired when participants could not rely on mental rehearsal. This suggests that learning a foreign language that is phonotactically dissimilar to the native language may present a greater challenge not only due to difficulty encoding word forms, but also because of reduced access to the semantic level of processing.

While the diminished ability to use an association-based strategy could have resulted in a compensatory increase in the use of other strategies, we found that those learning the unfamiliar language simply used fewer strategies overall. This likely contributed to the lower accuracy scores obtained from the unfamiliar language group, as we found that successful vocabulary acquisition was associated with the number of strategies that were adopted. Language learners and instructors may therefore benefit from being mindful of the relative difficulty of building spontaneous associations and focus on either emphasizing the importance and usefulness of finding semantic connections, or else explicitly promoting the use of other strategies when learning highly dissimilar languages.

Learners of dissimilar languages may especially benefit from the use of affective strategies, such as those that promote the management of mood as well as expectations. We find that participants' reported mood prior to beginning the task significantly predicted learning. Furthermore, we found a significant interaction between mood and frequency of strategy-use, in that using fewer strategies was especially detrimental for those reporting lower moods before beginning the task. This finding demonstrates the dynamic relationship between cognitive and affective factors, as a positive mood can help buffer against the disadvantages of infrequent strategy-use, while greater employment of cognitive strategies may help counteract the detrimental effects of negative emotions. In line with Samimy and Tabuse's (1992) finding that English learners of Japanese experienced a significant drop in both motivation and attitude over time, we observed a significant decrease in mood for learners of both the familiar and unfamiliar language. Furthermore, while mood did not vary between groups prior to the vocabulary task, those learning the unfamiliar language reported lower moods than the familiar group after the task. Given the compounding detrimental effects of low strategy-use and low mood, affective maintenance should be particularly emphasized when approaching the challenge of learning a highly dissimilar foreign language. In fact, affective maintenance may have implications beyond language learning and play a similar role in other cognitive tasks, with future research needed to examine and extend this finding.

In addition to the beneficial effects of positive moods, we observed that learners who had greater confidence used more strategies and were more successful on the vocabulary test. This result is consistent with past literature showing the positive effects of self-confidence for language learning (Pajares 2003; Raoofi *et al.* 2012). In contrast to our effect of mood on learning, however, we found that the effects of confidence on strategy-use and accuracy were more robust for the familiar language group than the unfamiliar group. One interpretation is that the beneficial effects of confidence may not extend to highly dissimilar languages. For instance, it may be the case that while confidence generally promotes the employment of useful strategies which would enhance language learning, it may not be sufficient to overcome obstacles such as the previously discussed difficulty of forming associations between the native language and a highly dissimilar foreign language. If so, it is possible that the reduced effect of confidence for dissimilar languages may be specific to vocabulary learning, as research suggests that cross-linguistic transfer (e.g. associations with the native tongue) may be less critical for tasks that are carried out after vocabulary is acquired (Melby-Lervåg and Lervåg 2011). Indeed, such an explanation would be consistent with Li and Wang's (2010) finding that self-confidence promoted the use of strategies for reading comprehension among Chinese speakers learning English, a relatively dissimilar language.

If we assume, however, that the positive relationship between confidence and performance is not causal, but rather a reflection of accurate competence judgments, we may infer that these self-evaluations are better calibrated for learning typologically similar languages. In other words, individuals may be fairly accurate at predicting their ability to learn languages similar to their native tongue, but not more dissimilar languages. It should be noted that participants in the present study did not know what type of language they would be learning when making their confidence judgments, whereas learners in a real-world setting would almost certainly be sensitive to the fact that certain languages are more difficult to learn than others. That said, there is substantial evidence from the overconfidence literature demonstrating that individuals consistently overestimate their competence, especially when actual competence is low (i.e. the 'Dunning–Kruger Effect;' Kruger and Dunning 1999). Given that discrepancies between expectations and reality can have a negative impact on motivation as well as learning (Ehrlinger and Shain 2014), enhancing meta-cognitive monitoring and managing expectations may be especially important for learners of more difficult, dissimilar languages.

Limitations

A potential limitation of our affective measures is our use of self-report questionnaires, which can be susceptible to demand characteristics (Paulhus and Reid 1991) and relies on participants' ability and willingness to provide accurate assessments (Gray and Watson 2007). Furthermore, as pre-task mood and confidence were not experimentally manipulated, their effects may be influenced by variables that could be confounded with the affective measures. For example, confidence in particular is likely to correlate with cognitive abilities that support language aptitude, such as phonological working memory (Gathercole and Baddeley 1989; Ellis 1996). Future research may therefore clarify the direct contribution of mood and confidence through experimental inductions of affective states, as well as the use of objective measures.

It would also be beneficial to obtain subjective reports of perceived linguistic distance (i.e. *psychotypology*, Kellerman 1978), as individual differences in cognitive and linguistic abilities (e.g. metalinguistic awareness), as well as language background (e.g. diversity of linguistic experience) are likely to moderate the learner's perceptions of typological similarity. It may be especially important to confirm that perceptions of linguistic distance align with the experimental manipulation when utilizing more complex language stimuli (such as those that contain morpho-syntactic characteristics) that can vary in similarity to the native tongue along multiple dimensions. Though individual variability in psychotypology was likely minimal in the present experiment given the simplicity of the artificial language (and the fact that effects of similarity were observed), replications with measures of psychotypology, as well as with more naturalistic stimuli will be useful to determine the generalizability of the findings. Future work would additionally benefit from exploring the impact of language similarity on affect, strategy-use, and achievement utilizing a wider range of tasks. Though paired-associate learning (as used in the present experiment) can be particularly effective for mapping form to meaning (Van Hell and Mahn 1997; Kasahara 2011), there has been growing appreciation for the benefits of more contextualized forms of instruction (see Godwin-Jones 2018), especially as learners progress beyond vocabulary acquisition.

Further research is also needed to determine whether the effects of language similarity observed in the present study generalize to aspects of language acquisition beyond vocabulary learning (e.g. syntax), as well as to native speakers of other Indo-European languages or languages which are typologically distinct from English. Based on models of the bilingual mental lexicon (e.g. Kroll and Stewart 1994), as well as empirical work describing the evolution of language knowledge over time (e.g. Parkinson and Dinsmore 2019), there is reason to expect that the benefits of phonotactic similarity on performance are likely to diminish as learners acquire the knowledge and skills necessary to adopt different, potentially more conceptually grounded strategies. For instance, it may be the case that advanced learners benefit more from cross-linguistic transfer at other levels of processing (e.g. pragmatics), or else are generally less reliant on the native tongue as L2 knowledge can become increasingly scaffolded to other L2 representations. In addition, the special status of English as a lingua franca can have specific consequences for various facets of language learning and use, including learners' motivational orientations (Sung 2013) and communication strategies (House 2003). As such, there may be variability among individuals depending on whether English is the source or target language (or neither), as well as the social context of learning (e.g. formal instruction versus immersion) and associated goals (e.g. 'correct' usage according to formalized standards versus effective communication; see Canagarajah 2007).

CONCLUSION

Comparing how people learn different languages can be difficult as a result of the many competing variables that influence natural language learning. Through the use of carefully constructed artificial languages, the present study was able to isolate the effect of similarity to the native tongue on early language learning. Our findings suggest that the relative difficulty of learning a highly dissimilar language results in part from a combination of cognitive and affective factors.

In sum, we observed that cognitive strategies, affective variables, and language similarity had both independent and interactive effects on language learning. Native English speakers learning a relatively similar language employed more strategies, which in turn improved learning outcomes.

Learners who had better moods and greater confidence prior to the task were more successful at learning. Following the task, those learning a dissimilar language reported both lower moods and confidence relative to those learning a similar language. Cognitive and affective variables interacted, such that greater pre-task confidence was associated with more strategy-use, and employing strategies was especially useful for those reporting lower pre-task moods.

The use of both cognitive and affective strategies may thus be particularly important for learners of challenging, dissimilar languages, as it is in these cases that strategies are least likely to be spontaneously utilized, yet most likely to be beneficial for counteracting the negative effects of discouragement. Though more work is needed to determine whether similar patterns are observed at later stages of acquisition when learners have attained higher levels of proficiency, as well as with different languages and populations, the present findings demonstrate that language-learning is a dynamic and interactive process that is highly variable, not only across individuals, but across languages as well.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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SUPPLEMENTARY DATA

Supplementary material is available at *Applied Linguistics* online.

NOTES

1 The high proportion of female participants was a result of the demographic composition of the class from which participants were recruited.

2 Note that no random effects of item were included because the outcome variable was calculated by aggregating across items. The by-subject random slope for Strategy was unidentifiable as each individual contributed a single

value (number of words) for each strategy.

3 These included multilingual status (monolingual vs. multilingual), age of non-English acquisition (AoA; with monolinguals assigned the maximum reported value of 24), non-English proficiency (with monolinguals assigned a value of 0), and amount of non-English exposure (with monolinguals assigned a value of 0).

4 The by-subject and by-item random slopes for Strategy were dropped from the model to achieve convergence.

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